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(54) Title of the invention: Computer graphic system provided with changing function for image illumination effect

(57) Abstract:
Object: To easily change the illumination effect of a display image.
Constitution: This system is provided with an input means 105 which directly sets the illumination effect such as a highlight position and the lightness of highlight position of the display image and a light source condition decision means 307 which rewrites light source data in a corresponding storage part 303 by finding the condition of a light source which satisfies a set illumination request command. The light source data in the corresponding storage part 303 is rewritten by finding conditions for the direction, position, luminance, etc., of the light source by adversely solving a shading

equation so as to satisfy requests for the highlighting position and the brightness, etc., inputted by the means 307. An image generating means 304 generates a 2D image based on rewritten light source data. In this way, it is possible to easily adjust the image provided with the illumination effect desired by a user.

[Claims]

[Claim 1] The configuration data that expresses the configuration of the body for a display and the view data which set up the view conditions of display images, such as a location and a direction, of seeing the mentioned above body, a storage means to store the light source data that set up the conditions of the light source that gives a light effect to the display image of the mentioned above body, an image generation means to generate the display image of the mentioned above body based on the mentioned above configuration data and view data that were stored in this storage means and light source data. The computer graphics system that has a display means to display the display image generated by this image generation means, an input means to input the lighting demand command that sets up the light effect in the front face of the mentioned above body of the mentioned above display image directly, the computer graphics system characterized by establishing the light source condition decision means that rewrites the light source data of the mentioned above storage part that correspond in quest of the conditions of the mentioned above light source of filling the mentioned above lighting demand command inputted from this input means.

[Claim 2] The computer graphics system generating a 3D configuration according to claim 1 characterized by that the mentioned above body is a 3D configuration and changing it by the mentioned above image generation means into a 2D image.

[Claim 3] The computer graphics system according to claims 1 or 2 characterized by that the mentioned above light source condition decision means adjusting the location of the mentioned above light source when this command is inputted including the command that directs the point of the arbitration that sets up the surface brightness of the body of the mentioned above display image highly as the mentioned above lighting demand command.

[Claim 4] The computer graphics system according to claims 1 or 2 characterized by that the mentioned above light source condition decision means adjusting the brightness of the mentioned above light source when this command is inputted including the command that specifies the value of the mentioned above surface brightness as the mentioned above lighting demand command.

[Claim 5] The computer graphics system according to claims 1 or 2 characterized by the mentioned above light source condition decision means adjusting the distance of the mentioned above light source and the mentioned above body when this command is inputted including the command that specifies the value of the mentioned above surface brightness as the mentioned above lighting demand command.

[Detailed description of the invention]

[0001]

[Industrial application] Especially this invention relates to the image generation computer graphics system including adjusting the light effect over the body at the time of displaying a 3D body by the 2D image.

[0002]

[Description of the prior art] Conventionally, if a user inputs the configuration data of a display body, light source data, view data, etc. into a computer first in case the image of a 3D scene is generated in a computer graphics system, a computer will generate an objective display image based on the inputted data and will display it on a screen. In order to attach a light effect to the image displayed as light source data, data, such as the direction of the light source that illuminates a body, a location and brightness, are the mentioned above, it is data that expresses the configuration of the body displayed as configuration data and view data is a data that specify the direction of the view of those who look at the body or a camera, a location, etc.

[0003] Thus, the user is made to generate the display image that has a desired light effect by changing the surface attribute of arrangement of the light source or a body through an input means to change the light effect of a display image as opposed to the generated image, looking at the image displayed on the screen.

[0004]

[Problems to be solved by the invention] However, according to the mentioned above prior art, in actuation of changing a light effect, since brightness must be set up predicting light effects, such as a highlights location of the body that wants to strengthen brightness most and its brightness, while changing the location of the light source by the 3D coordinate input, there is a problem that the actuation for acquiring a desired light effect is complicated.

[0005] The object of this invention is to offer the computer graphics system that can change the light effect of a display image easily.

[0006]

[Means for solving the problem] The configuration data that expresses the configuration of the body for a display in order that this invention may attain the mentioned above object, the view data that sets up the view conditions of display images, such as a location and a direction, of seeing a body, a storage means to store the light source data that sets up the conditions of the light source that gives a light effect to an objective display image, an image generation means to generate an objective display image based on the configuration data and view data and light source data that are stored in the storage means, in the computer graphics system that has a display means to display the display image generated by the image generation means characterized by establishing the light source condition decision means that rewrites the light source data of the storage part that correspond in quest of the conditions of the

light source of filling the lighting demand command inputted from an input means to input the lighting demand command that sets up the light effect in a display image directly and this input means.

[0007] A 3D configuration is changed into a 2D image and an image generation means generates it, when a body is a 3D configuration.

[0008] Including the command that directs the point of arbitration as a lighting demand command as a highlights location that sets up highly the brightness (objective surface brightness) of the front face of the body of a display image, when the command is inputted, a light source condition decision means is characterized by adjusting the location of the light source according to the highlights location. Also, it is characterized by a light source condition decision means adjusting the brightness of the light source, or the distance of the light source and a body in that case including the command that specifies the value of surface brightness.

[0009]

[Function] According to this invention, by establishing such means, the next operation can attain the mentioned above object.

[0010] Based on configuration data, view data and light source data, the 3D configuration that gave the light effect is changed into a 2D image by the formula generally called the shading equation mentioned later in a computer graphics system. The light source condition decision means of this invention rewrites light source data by solving the shading equation conversely.

That is, a user only sets up the light effect in a display image, for example, a highlights location, the brightness of the highlights location, etc. directly through an input means and rewrites the light source data of the storage part that correspond by the function of a light source condition decis ion means in quest of conditions, such as the direction of the light source with which the set-up light effect is filled, a location and brightness. An image generation means generates a 2D image based on the rewritten light source data. Consequently, it can adjust to what a user expects the light effect of an image of easily.

[0011] That is, according to the shading equation, when the light source is located in the direction opposite to the direction of a look to the direction of a normal on the front face of a body of the location of arbitration, the brightness of the location becomes the strongest. Then, when for example, a highlight location is specified, a light source condition decision means looks for the configuration data of the part currently displayed on the highlights location and asks for the normal vector of the configuration of the point. Next, according to 3D system of coordinates, the direction vector of an eye direction is searched for from the specified highlights location. And the location of the light source is set up in the direction of a look and the direction of the opposite side to a normal vector. Thus, by generating an image again based on the changed light source data, brightness of the specified highlights location can be enlarged most.

[0012] Also, based on the brightness of a shaped surface, it can ask for the brightness of the light source by solving a shading equation.

[0013]

[Example] Next, this invention is explained based on an example. The system configuration drawing of the computer graphic system of one example of this invention is shown on drawing 1. If it roughly divides, it is constituted including the input means 105, such as a mouse for inputting directions of the indicating equipment 104 that displays the image and the required information on the central processing means 101 that performs the control and the operation of processing of this system, the data storage 103 that stores various kinds of data concerning processing and a processing result on a screen and a user and a keyboard.

[0014] A central processing means 101 is constituted including the image generating means 304, the image display part 305, the configuration selection / normal operation part 306, the light source condition decision means 307 and the input-control part 308.

The image generating means 304 generates a 2D image from configuration data, view data and light source data.

The image display part 305 performs control that displays the generated image on a display 104.

Configuration selection / normal operation part 306 looks for the configuration data of the body corresponding to the directing point of the screen directed by cursor etc. from data storage 103 based on the directions inputted by the input-control part 308 and calculates the normal of the configuration in the point

location. The light source condition decision means 307 calculates the conditions of the optimal light source from the count conditions of lighting count, the configuration data of the body corresponding to the directing point of a screen, the normal data called for by configuration selection / normal operation part 306 and view data. The input-control part 308 interprets the command and directions that are inputted from an input means 105 and performs a processing request to each part.

[0015] The data storage part 103 includes the shape memory part 301, the view data storage part 302, the light source data storage part 303 and the count condition storage part 309. As shown on drawing 2, the configuration data that consists of coordinate data, a parameter, etc. that expressed the configuration element 401 of the body for a display with the coordinate value in 3D space are stored in the shape memory part 301.

[0016] The configuration elements 401 are a triangle, a globular form, etc. and in the case of a triangle, it is expressed by three top most vertices coordinate data and, in a globular form case, is expressed by the data of a main coordinate and a radius. Also, as a parameter is shown on drawing 3, surface data, such as surface roughness related to the light effect of the configuration element and a reflection coefficient, are included.

[0017] As shown on drawing 4, the data showing the magnitude of the screen in the case of generating the location data 501 that expressed the location of the view in 3D space, the direction of a look, the rotation inclination of a rectangle screen, etc. with the form of

matrix data, the field angle data 502 equivalent to the solid angle (for example, field angle of a camera) showing a visual field and an image of screen size 503 grade are included in the view data storage part 302.

[0018] In the case of the light source classification 602, the light source location 603 and the spot light source, data, such as the angle of divergence 604 of the light source, the light source brightness 605, the brightness 606 of the ambient light of the light source and the direction of the light source, are included in the light source data storage part 303. As a classification 602 of the light source, the spot light source that has the direction of a light emission and breadth in all the directions to the point light source and the point light source that emit light can be considered, for example from the parallel light source assumed that the light source is in an infinite point and one point. Also, the light source can store the light source data about each light source in the form of a table 601, so that more than one can be used simultaneously.

[0019] Count conditions required as shown on drawing 6, in order to calculate lighting are stored in the count condition storage part 309. That is, the light source distance 704 showing the distance to the light source classification 701, the location data 702 of the point that the display image set as the object of lighting count was specified, the direction 703 of the light source and the light source, the brightness 705 of the light source, the surface lightness 705 that specifies the brightness of the front face of a display body, the highlights assignment flag 707 that stores whether there were any directions of

a user about those values further and directions condition flag 708 grade are included like illustration.

[0020] Next, the detail configuration of each part is explained with actuation. First, outline actuation is explained with reference to an example of the interactive screen displayed on the display 104 shown on drawing 7. In addition, the light source in this drawing is expressed for explanation and does not need to be displayed as an image. A user directs to a system using cursor 201, a menu 203, etc. which an input means 105 displays. Usually, it directs to make each data of the shape memory part 301, the view data storage part 302 and the light source data storage part 303 search first and to generate a desired image in the image generating means 304. The image generating means 304 generates a 2D image based on the 3D configuration data of the body displayed with reference to each data. The generated image is displayed on a display 104 through the image display part 305.

A user inputs a changing condition into the input-control part 308 through an input means 105 to change the highlights location 202 that wants to strengthen brightness most and its brightness to the image 204 of the displayed body. A user can perform directions required for image generation and a command by the cursor 201 and menu 203 that are displayed on the screen. An example of a menu is shown on drawing 8. For example, cursor 201 is moved, the point is directed and, subsequently to "ON", highlights directions of a menu are carried out to specify the highlights location 202 of the image 204 of the displayed body and set the

maximal value of brightness as the location. It requests that the input-control part 308 calculates the conditions of the light source according to the conditions changed to the light source condition decision means 307 after storing the directed conditions in the count condition storage part 309. The light source condition decision means 307 asks to search for the direction of a normal on the front face of a body in the configuration and the location of a point of the body corresponding to the point directed with cursor 201 configuration selection / direction normal operation part 306.

And based on the configuration and the direction of a normal that were searched for by configuration selection / direction normal operation part 306, the count conditions stored in the count condition storage part 309 and the view data stored in the view data storage part 302, an operation determines the conditions of the light source according to the procedure mentioned later.

After storing the conditions that the determined light source changed in the light source data storage part 303, a request of image generation is again performed from the input-control part 308 to the image generating means 304 and the image with that the light effect was changed by this is displayed on a display 104.

Similarly, the brightness (surface brightness) of the highlights location 202, a color, the other brightness of front faces other than the highlights location of the body image 204 and a color can be directed with a menu 203.

Thus, since light source data, such as a location of the light source, a direction and brightness, calculate automatically and the contents of the light source data

storage part 302 are rewritten by directing the conditions of lighting directly to an image, a user can give the light effect of a request of a user easily to an image.

[0021] Here, the contents of the processing performed in each part of a central processing means 101 are explained with reference to drawings 9 - 14. Drawing 9 shows the processing flow of the input-control part 308. A user requests various kinds of processings to a system with an input means 105. The modification processing of a light effect to a display image is explained.

The input-control part 308 judges whether it is the location input of a directing point with cursor at step 801, when there is an input. If it is a location input, the data of a location inputted at step 807 are stored in the location data 702 of the count condition storage part 309.

Next, a directing point judges whether it is a thing accompanied by highlights directions at step 808. If it is highlights directions, the highlights assignment flag 707 will be set at step 809. If it is not highlights directions, a highlights assignment flag will be cleared at step 810. Decision whether they are highlights directions is judged by the command input of a menu 203.

[0022] When an input is not a location input in decision of step 801, it progresses to step 802 and judges whether an input is assignment of light source classification.

In affirmation, the classification (parallel light source, point light source, etc.) of the light source inputted at step 811 is stored and set as the light source classification 701 of the count condition storage part

309. When it is not the assignment input of light source classification, it judges whether an input is lightness assignment of a directing point at step 803.

In affirmation, the lightness inputted at step 812 is set as the surface lightness 706 of the count condition storage part 309. When it is not the assignment input of lightness, it judges whether it is the input which specifies the brightness of the light source at step 804.

If it is the input which specifies the brightness of the light source, the specified light source brightness will be set as the light source brightness 705 of the count condition storage part 309 at step 813.

[0023] It judges whether it is the input as which it will progress to step 805 and an input will specify the distance from a directing point to the light source by decision of step 804 if an input is not brightness assignment of the light source. If it is distance assignment, the distance to the light source will be set as the light source distance 704 of the count condition storage part 309 at step 814. On the other hand, when it is not the input that specifies light source distance, it judges whether they are directions of a setup/discharge of count conditions at step 806. If it is directions of a setup/discharge, the set (setup)/un set (discharge) of the flag of the directions condition flag 708 will be performed at step 815.

When the directions condition flag 708 is a set, the light source condition decision means 307 uses the corresponding condition data, when determining the conditions of the light source.

[0024] Thus, when the input-control part 308 has a certain input, in step 816, the conditions of the light source according to the directed conditions are calculated to the light source condition decision means 307 and modification of the data of the light source data storage part 303 is directed. These directions are based on the light source condition decision means 307, the procedure on drawing 10 following new light source data, an operation asking the data of the light source data storage part 303.

After this modification is completed, the input-control part 308 requests generation of the new image after modification to the image generating means 304 at step 817.

[0025] Next, processing actuation of the light source condition decision means 307 is shown on drawing 10. First, the count approach of the light source data in the light source condition decision means 307 is explained with reference to drawing 11. The relation with the surface reflective attribute of the lightness of an objective front face, view data, light source data and a body can be expressed with the shading equation (Equation 1, Equation 2, Equation 3) showing in a degree type.

[0026]

[Equation 1]

$$I = Ka * Ia + Kd * (\vec{I}s \cdot \vec{N}) + Ks * (\vec{H} \cdot \vec{N})^{n} * Is \quad \cdots\cdots (1)$$

[0027]
[Equation 2]

$$\vec{H} = \frac{\vec{V} + \vec{I}_s}{|\vec{V} + \vec{I}_s|} \qquad \cdots\cdots (2)$$

[0028]
[Equation 3]

$$I_s = \frac{I_{sorg}}{Cd0 + Cd1 * d + Cd2 * d^2} \qquad \cdots\cdots (3)$$

[0029] In those formulas, Ka, Kd and Ks are surface reflection coefficients, are an ambient light reflection coefficient, a diffuse reflection multiplier and a specular reflection factor, respectively and are a constant that becomes settled with a surface attribute. In n, a surface roughness factor and Isorg show light source brightness and Ia shows the brightness of ambient light, respectively. In N, the direction vector of the light source and V show the direction vector to a view and, as for the normal vector of a directing point and Is, d shows the distance of a directing point front face and the light source. Cd0, Cd1 and Cd2 show the multiplier at the time of the luminous intensity from the light source declining according to distance. The value I that can be found by Equation 1 is objective surface lightness (color). In addition, let each vector be a means vector. The brightness Ia of ambient light and the damping coefficients Cd0, Cd1 and Cd2 of light are constants that become settled according to an environment.

The light source condition decision means 307 counts light source data, such as a location of the light source and brightness, backward using the mentioned above formula so that the conditions specified by the count condition storage part 309 and the contents of the shape memory part 301 and the view data storage part 302 may be suited.

[0030] Processing of this light source condition decision means 307 is explained along with drawing 10. Conditions required for count are read from the count condition storage part 309 at step 901. The configuration in the directing point location specified as the location data 702 to configuration selection / normal operation part 306 at step 902 is chosen and it requests to ask for the normal vector of the shaped surface in the directing point. Answering this, configuration selection / normal operation part 306 performs selection of a configuration and the operation of a normal vector according to the flow chart shown on drawing 12. Next, at step 903, a flag 707 is seen and it judges whether directing points are highlights directions. If it is highlights directions, it will progress to step 904, otherwise, will progress to step 915.

[0031] At step 904, the light source that starts modification directions with reference to the light source classification 701 judges the parallel light source or the point light source. If it is the parallel light source, it will progress to step 905, otherwise, will progress to step 908.

[0032] At step 905, it judges whether the lightness of a directing point is specified with reference to the directions condition flag 708 corresponding to the surface lightness 706. When lightness is set up, if not progressed and set as step 906, it progresses to step 907.

[0033] At step 906, the specified point is made into a highlights location and the direction and brightness of the light source are calculated so that the light source may become the value of the surface lightness 706 as which the surface lightness of a highlights location was specified by the parallel light source. Highlights should just search for the vector Is that expresses the direction of the light source that Vector H and Vector N of Equation 1 become the same. This condition is fulfilled by Equation 4 of a degree type. Let each vector be a means vector in this formula.

[0034]

[Equation 4]

$$\vec{I}s = 2 * (\vec{N} \cdot \vec{V}) * \vec{N} - \vec{V} \qquad \cdots\cdots (4)$$

[0035] Subsequently, in order to search for the lightness of a directing point, the value of the surface lightness 706 specified as Equation 1 I is assigned and it asks for the brightness Isorg of the light source corresponding to this. In addition, since the light source is the parallel light source, there is no attenuation by distance and each of Cd1 and Cd2 is 0. Thus, the direction and brightness of the light source searched for are set as the area where the light source data storage part 303 corresponds at step 926.

[0036] Since lightness is not specified when it progresses to step 907, only the direction Is of the light source is searched for with the procedure mentioned above and the direction of the light source searched for is set as the area where the light source data storage part 303 corresponds at step 926.

[0037] When it progresses to step 908, it judges whether it is the no as which the lightness of a directing point is specified like step 905. If are specified and it is not specified as step 909, it progresses to step 914. At step 909, it judges whether the brightness of the light source is specified. This judgment is made with the directions condition flag 708 corresponding to the light source brightness 705 of the count condition storage part 309. In the case where light source brightness is specified, if not specified step 910, step 911 is performed.

[0038] At step 910, the distance to the light source is found from the direction of the light source and a directing point using the mentioned above formula so that the light source may become the value of the surface lightness 706 as which the directing point was considered as highlights and the lightness of a directing point was specified according to the point light source by the brightness of the value specified as the light source brightness 705. In this case, since the light source is the point light source, damping coefficients Cd0, Cd1 and Cd2 are taken into consideration.

[0039] At step 911, it judges whether the distance from a directing point to the light source is specified. This judgment is made with reference to the directions condition flag 708 corresponding to the light source

distance 704 of the count condition storage part 309. When the distance to the light source is specified, step 912 is performed and step 13 is performed when not specified.

[0040] At step 912, the value and the directing point that the light source was set as the light source distance 704 of the count condition storage part 309 in the distance from the point light source and a directing point to the light source are considered as highlights and it asks for the direction and brightness of the light source using the mentioned above formula, so that lightness may become the value specified as the surface lightness 706. The light source data for which it asked are set as the light source data storage part 303 like the mentioned above in step 926.

[0041] At step 913, several highlights locations are performed, when set up on a body front face. Thus, after the directions conditions about several directing points are inputted and gathering, with the application of Equation 1, simultaneous equations are calculated about each directing point. Since the lightness in each highlight location is specified, count asks for the brightness of the location of the light source, i.e., a direction, distance and the light source, so that they may be satisfied. Simultaneous equations are stood and since the lightness of a highlights location is not specified at step 914, the direction and distance of the light source are found so that the assignment conditions over several directing points may be fulfilled, so that a highlights location may be satisfied.

[0042] At step 915, the light source that starts modification directions with reference to the light source classification 701 judges the parallel light source or the point light source like step 904. If it is the parallel light source, it will progress to step 916, otherwise, will progress to step 919. At step 916, it judges whether the lightness of a directing point is specified like step 905 with reference to the directions condition flag 708 corresponding to the surface lightness 706. When lightness is set up, if not progressed and set as step 917, it progresses to step 918.

[0043] At step 917, light source brightness is calculated so that the light source may become the value of the surface lightness 706 as which the surface lightness of a directing point was specified by the parallel light source. At step 918, since it is incalculable with lack of count conditions, an error message is performed.

[0044] At step 919, it judges whether the lightness of a directing point is specified like step 905 with reference to the directions condition flag 708 corresponding to the surface lightness 706. When lightness is set up, if not progressed and set as step 920, it progresses to step 925.

[0045] At step 920, it judges whether the brightness of the light source is specified like step 909. This judgment is made with the directions condition flag 708 corresponding to the light source brightness 705 of the count condition storage part 309. The case where light source brightness is specified and if not specified step 921, step 922 is performed.

[0046] At step 921 by the point light source, the light source finds the distance to the light source, so that the lightness of a directing point may become the value of the surface lightness 706 with the value of the light source brightness 705. At step 922, when it judges whether the distance to the light source is specified with reference to the corresponding directions condition flag 708 like step 911 and are specified and step 923 is not specified, step 924 is performed, respectively.

[0047] At step 923, according to the point light source, the light source finds the distance to the light source based on the mentioned above formula so that the distance to the light source may be the distance specified as the light source distance 704 and it may become the surface brightness 706 as which the brightness of a directing point was specified.

At step 924, it asks for the location and brightness of those light sources by considering the lighting by several point light sources and performing several point directions. At step 925, since it is incalculable with lack of count conditions, an error message is performed.

[0048] The conditions of the light source searched for by the above count are set as the light source data storage part 303 at step 926.

[0049] Next, processing of configuration selection / normal operation part 306 is explained with drawing 12. This processing is performed by being called from the light source condition decision means 307, chooses the configuration of the body corresponding to a directing point from the shape memory part 301, asks for the normal vector in the directing point of that configuration

and returns it to the light source condition decision means 307. That is, one configuration data of the location corresponding to a directing point is read from the shape memory part 302 at step 1103. The read configuration is changed into the view system of coordinates based on view data at step 1104. Thus, if it judges at step 1105 whether the configuration is drawn by the directing point of a screen and step 1106 progresses and it is not drawn when drawn, it progresses to step 1108. At step 1106, the normal vector of the shaped surface corresponding to a directing point is calculated and a count result is returned to the light source condition decision means 307 in step 1107. At step 1108, when it judges whether the configuration that should still draw exists in the shape memory part 301 and exists in it, it returns to step 1103 and processing is repeated. If it does not exist, it returns that a configuration was not able to be chosen at step 1109 to the light source condition decision means 307.

[0050] Processing of the image generating means 304 is explained with drawing 13. First, at step 1201, view data are read from the shape memory part 301 and the view data storage part 302 to light source data are read for configuration data from the light source data storage part 303, respectively. Next, in step 1202, it is with the shading equation 1 about all configuration elements and color count of the point of each screen is performed. The result is transmitted to the image display part 305 at step 1203.

[0051] In the image display part 305, as shown on drawing 14, the point data of each screen transmitted in step 1301 are incorporated and a color is written in the point of a screen that a display 104 corresponds in step 1302. Thus, when a user specifies a direct location on an image and specifies the light effect of the location, conditions, such as a location of the light source that realizes the light effect, a direction and brightness are calculated automatically and a desired image can be easily obtained from the light effect of a display image being changed based on the result.

[0052]

[Effect of the invention] According to this invention, a desired light effect can be acquired by only directing a desired highlights location, lightness, etc. directly, without directing the location of the light source etc. with the coordinate of 3D space in computer graphics in setting up the light effect of a display image, as explained above.

[Brief description of the drawings]

[Drawing 1] is the system configuration general drawing of one example of this invention.

[Drawing 2] is drawing showing an example of the contents of data of the shape memory part.

[Drawing 3] is drawing showing an example of the surface data of the configuration of the shape memory part.

[Drawing 4] is drawing showing an example of the contents of data of the view data storage part.

[Drawing 5] is drawing showing an example of the contents of data of the light source data storage part.

[Drawing 6] is drawing showing an example of the contents of data of the count condition storage part.

[Drawing 7] is drawing showing an example of the display screen according to the example of this invention.

[Drawing 8] is drawing showing an example of a menu.

[Drawing 9] is the flow chart that shows the procedure of the input-control part.

[Drawing 10] is the flow chart that shows the procedure of the light source condition decision means.

[Drawing 11] is drawing explaining count by the shading equation.

[Drawing 12] is the flow chart that shows the procedure of configuration selection / normal operation part.

[Drawing 13] is the flow chart that shows the procedure of the image generating means.

[Drawing 14] is the flow chart that shows the procedure of the image display part.

[Description of numbers]

101 central processing means

103 data storage

104 display

105 input means

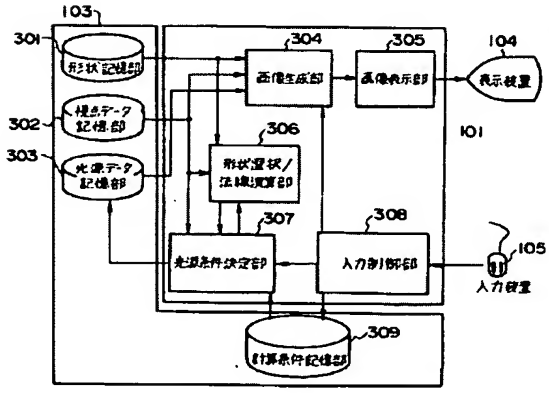
301 shape memory part

302 view data storage part

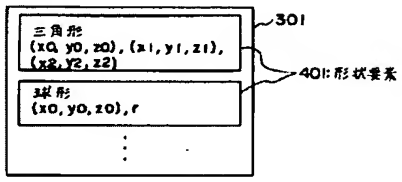
303 light source data storage part

304 image generating means
305 image display part
306 configuration selection / normal operation part
307 light source condition decision means
308 input-control part
309 count condition storage part

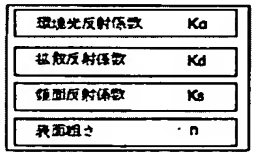
Drawing 1



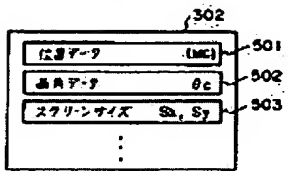
Drawing 2



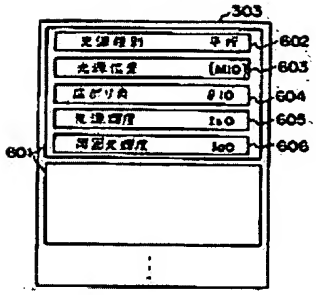
Drawing 3



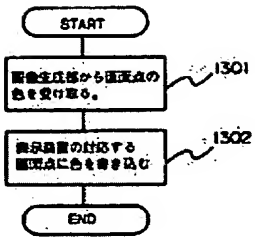
Drawing 4



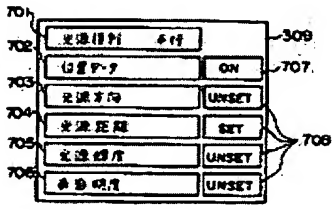
Drawing 5



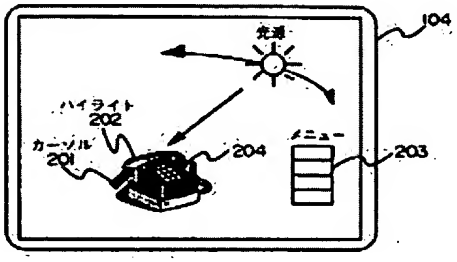
Drawing 14



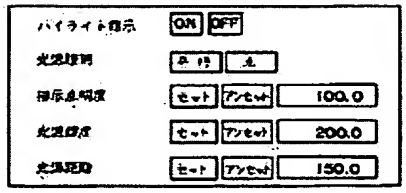
Drawing 6



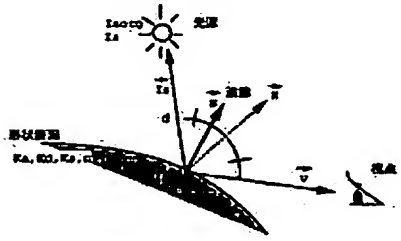
Drawing 7



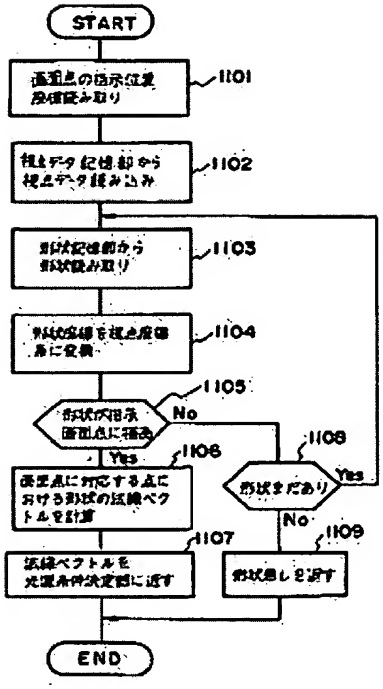
Drawing 8



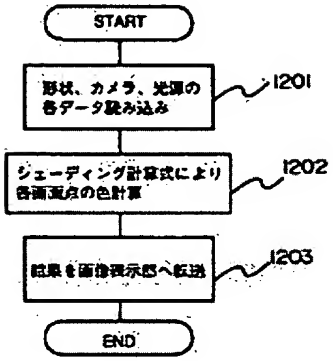
Drawing 11



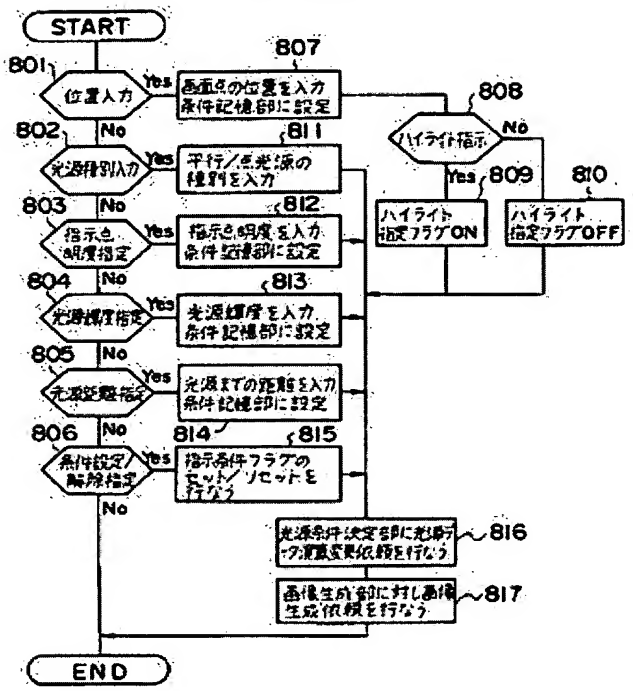
Drawing 12



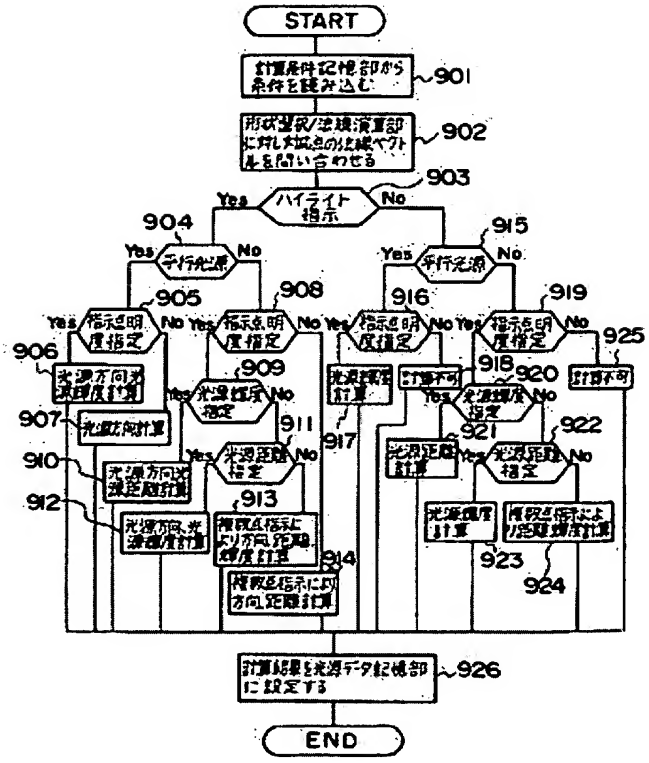
Drawing 13



Drawing 9


START
801
位置入力
Yes
807
画面上の位置を入力
条件記憶部に設定
No
802
光源種別入力
Yes
811
平行/点光源の
種別を入力
No
803
指示色
明度指定
Yes
812
指示色,明度を入力
条件記憶部に設定
No
804
光源輝度指定
Yes
813
光源輝度を入力
条件記憶部に設定
No
805
光源距離指定
Yes
光源までの距離を入力
条件記憶部に設定
No
806
条件設定/
解除指定
Yes
814
815
指示条件フラグの
セット/リセットを
行なう
No
808
ハイライト指示
No
Yes
809
ハイライト
指定フラグON
810
ハイライト
指定フラグOFF
光源条件決定部に処理フ
ラグ変更要求を行なう
816
画像生成部に対し画像
生成依頼を行なう
817
END

Drawing 10


START
901
902
903
ハイライト指示
Yes
No
904
平行光源
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
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925
926
END